



FCC LISTED, REGISTRATION
NUMBER: 720267

Informe de ensayo n°:
Test report No:

NIE: 51748RRF.002

Partial Test report

USA FCC Part 15.247, 15.209

Radio Frequency Devices. Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and
5725 - 5850 MHz.

Radiated emission limits; general requirements.

Identificación del objeto ensayado.....: Identification of item tested	Wireless sensor node for Smart Parking (Internet of Things)
Marca Trademark	Libelium
Modelo y/o referencia tipo Model and /or type reference	Smart Parking US
Other identification of the product	FCC ID: XKM-PARKING-V1
Final HW version	1.0
Final SW version	1.0
Características Features	Can communicate with Sigfox and LoRaWAN networks. USA version. Contains a TD1508 chipset and an RN2903 chipset.
Fabricante Manufacturer	LIBELIUM COMUNICACIONES DISTRIBUIDAS SL C/ Escatrón 16 (Edificio Libelium), CP: 50014, Zaragoza (SPAIN)
Método de ensayo solicitado, norma.....: Test method requested, standard	USA FCC Part 15.247 10-1-15 Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 10-1-15 Edition: Radiated emission limits; general requirements. FCC 15.247 Subclause (d) (radiated) Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v03r05 dated 04/08/2016. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Resultado.....: Summary	IN COMPLIANCE
Aprobado por (nombre / cargo y firma) Approved by (name / position & signature)	A. Llamas RF Lab. Manager
Fecha de realización Date of issue	2017-06-08
Formato de informe No.: Report template No	FDT08_19

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General conditions

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Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA Testing and Certification internal document PODT000.

Usage of samples

Samples undergoing test have been selected by: **the client**

Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
51748/033	Wireless sensor node for Smart Parking	Smart Parking US	---	2017-02-06

1. Sample S/01 has undergone following test(s).
All radiated tests indicated in appendix A for Sigfox radio.

Sample S/02 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
51748/028	Wireless sensor node for Smart Parking	Smart Parking US	---	2016-12-27

1. Sample S/01 has undergone following test(s).

All radiated tests indicated in appendix B for LoRaWAN radio.

Test sample description

The test sample consists of a device that detects vehicles with its sensor unit and sends information with its wireless radios. It is battery powered and can be easily configured.

Identification of the client

LIBELIUM COMUNICACIONES DISTRIBUIDAS SL

C/ Escatrón 16 (Edificio Libelium), CP: 50014, Zaragoza (SPAIN)

Testing period

The performed test started on 2017-01-27 and finished on 2017-02-07.

The tests have been performed at DEKRA Testing and Certification.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω
Normal site attenuation (NSA)	< ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
Field homogeneity	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

Remarks and comments

- 1: Test not requested. Only radiated radiated spurious emissions tests were requested.
- 2: The tests have been performed by the technical personnel: Pedro Parada and Carlos Contreras.
- 3: Used instrumentation:

Radiated Measurements

		Last Cal. date	Cal. due date
1.	Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2.	BiconicalLog antenna ETS LINDGREN 3142E	2014/03	2017/03
3.	Multi Device Controller EMCO 2090	N.A.	N.A.
4.	Double-ridge Guide Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D	2016/11	2019/11
5.	Broadband Horn antenna 18-40 GHz SCHWARZBECK BBHA 9170	2014/03	2017/03
6.	EMI Test Receiver R&S ESU 40	2016/03	2018/03
7.	Spectrum analyser Rohde & Schwarz FSW50	2015/12	2017/12
8.	RF pre-amplifier 10 MHz-6 GHz SCHWARZBECK BBV9743	2016/04	2017/04
9.	RF pre-amplifier 1-18 GHz Bonn Elektronik BLMA 0118-1M	2016/02	2018/02

Testing verdicts

Not applicable	N/A
Pass	P
Fail	F
Not measured	N/M

FCC PART 15 PARAGRAPH		VERDICT			
		NA	P	F	NM
FCC 15.247 Subclause (a) (1)	20 dB Bandwidth and Carrier frequency separation				NM ¹
FCC 15.247 Subclause (a)(1)(iii)	Number of hopping channels				NM ¹
FCC 15.247 Subclause (a)(1)(iii)	Time of occupancy (Dwell Time)				NM ¹
FCC 15.247 Subclause (b)	Maximum peak output power and antenna gain				NM ¹
FCC 15.247 Subclause (d)	Emission limitations conducted (Transmitter)				NM ¹
FCC 15.247 Subclause (d)	Emission limitations radiated (Transmitter)		P		

1: see section "Remarks and Comments".

Appendix A – Test result. Sigfox radio

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TEST CONDITIONS	9
FCC Section 15.247 Subclause (d). Emission limitations radiated (Transmitter)	11

TEST CONDITIONS

$V_{\text{nominal}} = 3.6 \text{ Vdc}$

Type of power supply = Lithium battery.

Type of antenna = internal antenna

Temperature (°C):

$T_n = +15 \text{ to } +35$

$T_{\text{min}} = \text{N/A}$

$T_{\text{max}} = \text{N/A}$

The subscript n indicates normal test conditions.

N/A: Not Applicable.

TEST FREQUENCIES:

Lowest channel: 902.2 MHz

Highest channel: 904.6 MHz

The Software of EUT was used to configure to transmit continuously at maximum power (Level adjustment 24) in all tested channels.

RADIATED MEASUREMENTS

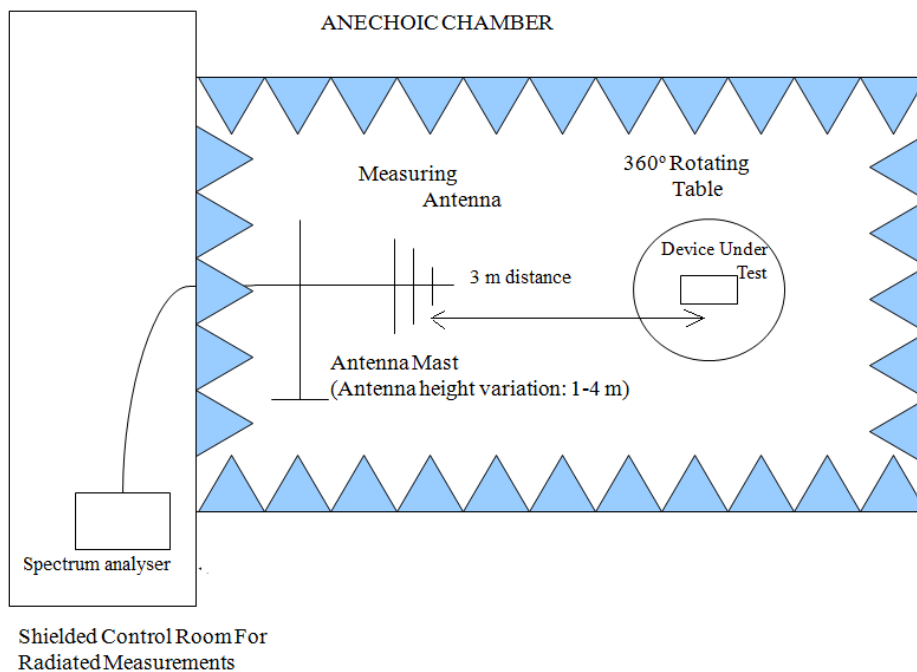
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-10 GHz (1 GHz-18 GHz Double ridge horn antenna).

For radiated emissions in the range 1 GHz-10 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

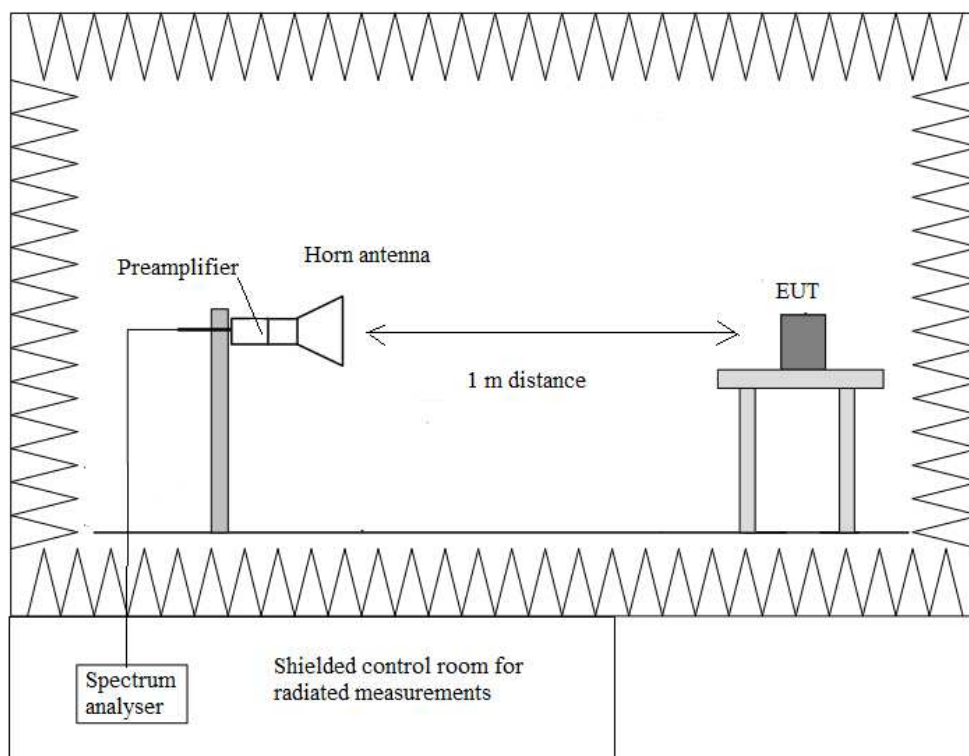
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

Radiated measurements setup $f < 1$ GHz



Radiated measurements setup $f > 1$ GHz



FCC Section 15.247 Subclause (d). Emission limitations radiated (Transmitter)

SPECIFICATION

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)):

Frequency Range (MHz)	Field strength ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-1000 MHz and at distance of 1m for the frequency range 1 GHz-10 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

Frequency range 30 MHz-1000 MHz.

All spurious signals are more than 20 dB respect to the limit.

Frequency range 1 GHz-10 GHz

1. CHANNEL: LOWEST (902.2 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
1.80445 (*)	H	Peak	61.80	± 4.69
		AVG	61.61	± 4.69
2.70655	H	Peak	46.93	± 4.69
3.60865	V	Peak	43.01	± 4.69
4.51105	H	Peak	50.93	± 4.69
6.31555	V	Peak	41.90	± 4.69
7.21765	H	Peak	46.12	± 4.69
8.11975	V	Peak	43.59	± 4.69

(*): This spurious frequency is outside the restricted bands as defined in §15.205(a). The measured maximum carrier level at 3 m was 115.16 dB μ V/m (Peak) so the spurious level is more than 30 dB below the carrier level.

2. CHANNEL: HIGHEST (904.6 MHz).

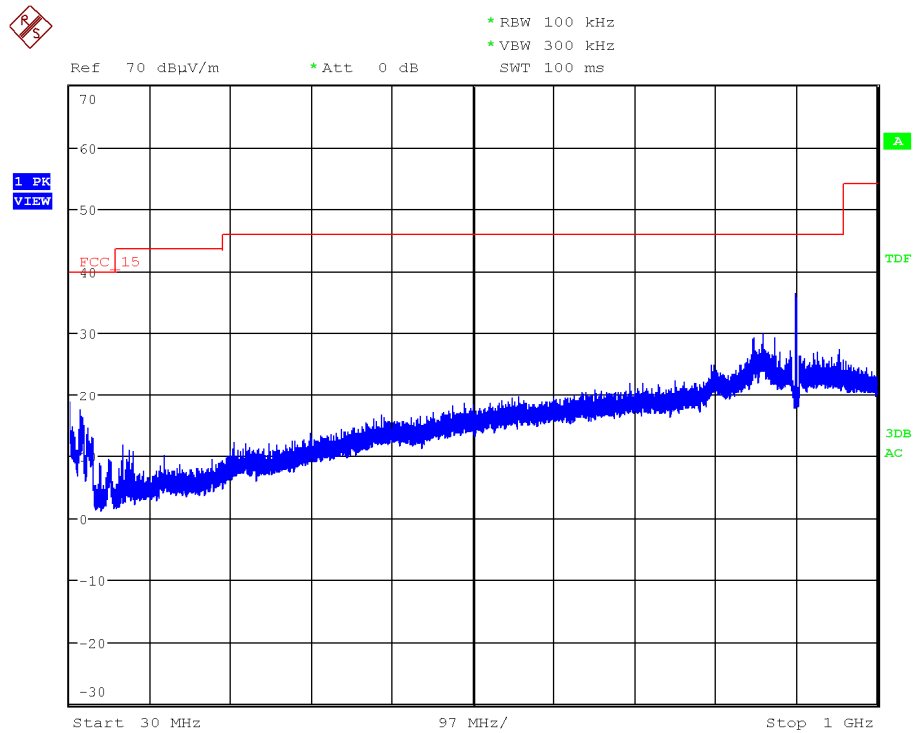
Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
1.80925 (*)	H	Peak	62.52	± 4.69
		AVG	62.34	± 4.69
2.71375	V	Peak	48.44	± 4.69
3.61825	V	Peak	42.81	± 4.69
4.52305	H	Peak	54.68	± 4.69
		AVG	54.26	
5.42755	V	Peak	39.72	± 4.69
6.33235	V	Peak	42.46	± 4.69
7.23715	H	Peak	48.29	± 4.69
8.14135	V	Peak	45.74	± 4.69

(*): This spurious frequency is outside the restricted bands as defined in §15.205(a). The measured maximum carrier level at 3 m was 116.15 dB μ V/m (Peak) so the spurious level is more than 30 dB below the carrier level.

Verdict: PASS

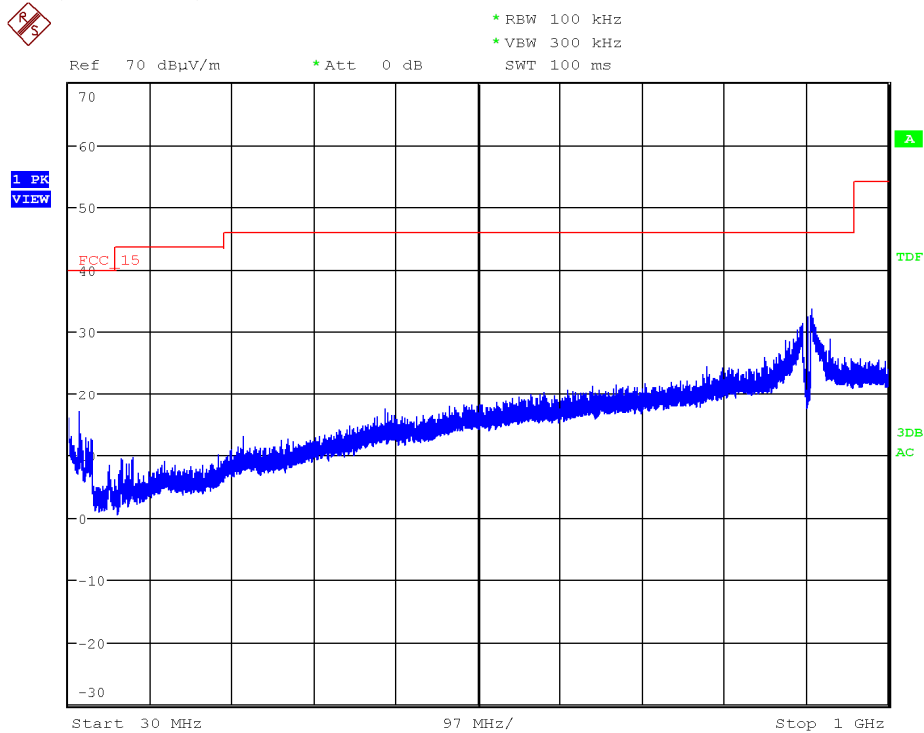
FREQUENCY RANGE 30 MHz-1000 MHz.

CHANNEL: Lowest (902.2 MHz).



Note: The carrier was attenuated using a Notch filter.

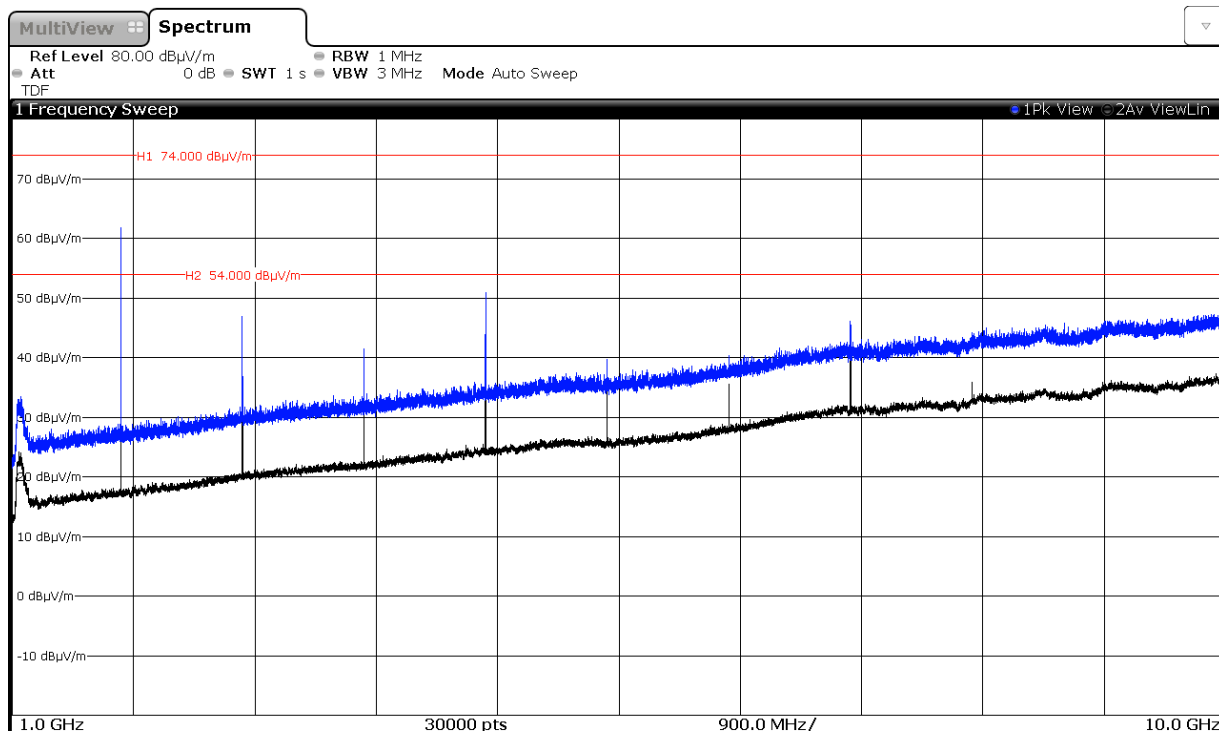
CHANNEL: Highest (904.6 MHz).



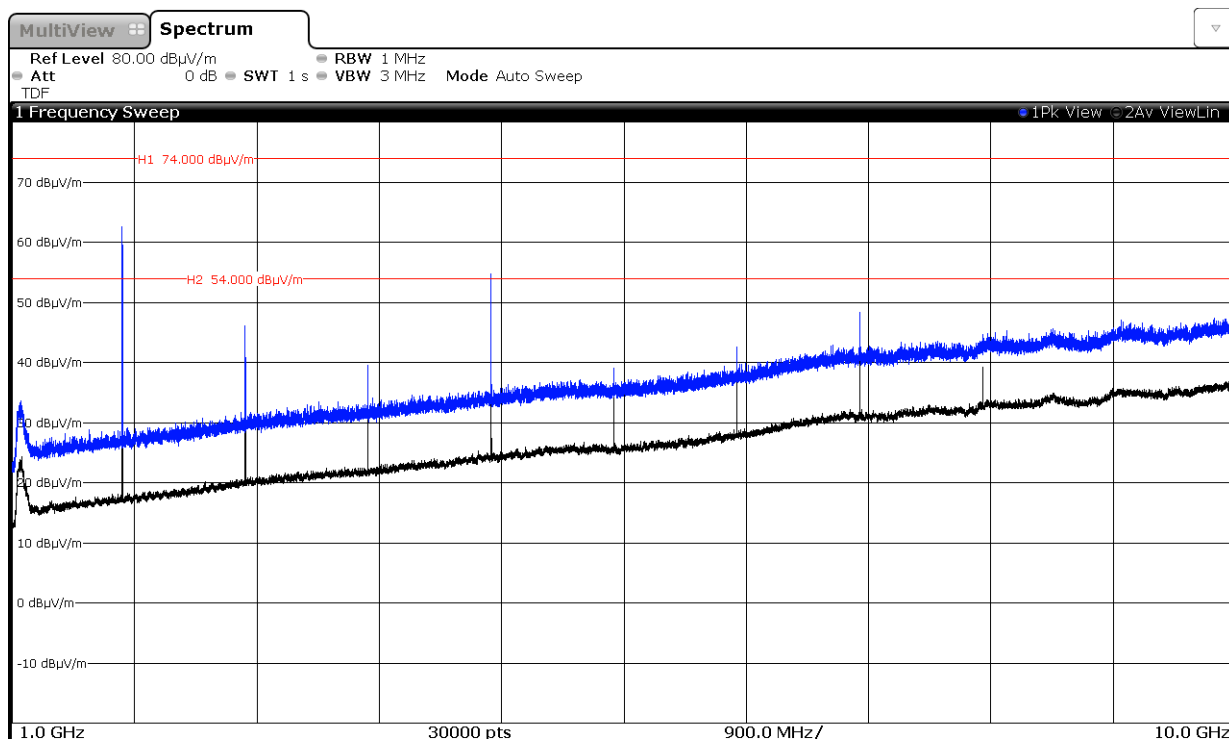
Note: The carrier was attenuated using a Notch filter.

FREQUENCY RANGE 1 GHz to 10 GHz.

CHANNEL: Lowest (902.2 MHz).



CHANNEL: Highest (904.6 MHz).



Appendix B – Test result. LoRaWAN radio

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TEST CONDITIONS	17
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TEST CONDITIONS

$V_{\text{nominal}} = 3.6 \text{ Vdc}$

Type of power supply = Lithium battery.

Type of antenna = internal antenna

Temperature (°C):

$T_n = +15 \text{ to } +35$

$T_{\text{min}} = \text{N/A}$

$T_{\text{max}} = \text{N/A}$

The subscript n indicates normal test conditions.

N/A: Not Applicable.

TEST FREQUENCIES:

Lowest channel: 902.3 MHz

Middle channel: 908.7 MHz

Highest channel: 914.9 MHz

The Software of EUT was used to configure to transmit continuously at maximum power (Level adjustment 20) in all tested channels.

RADIATED MEASUREMENTS

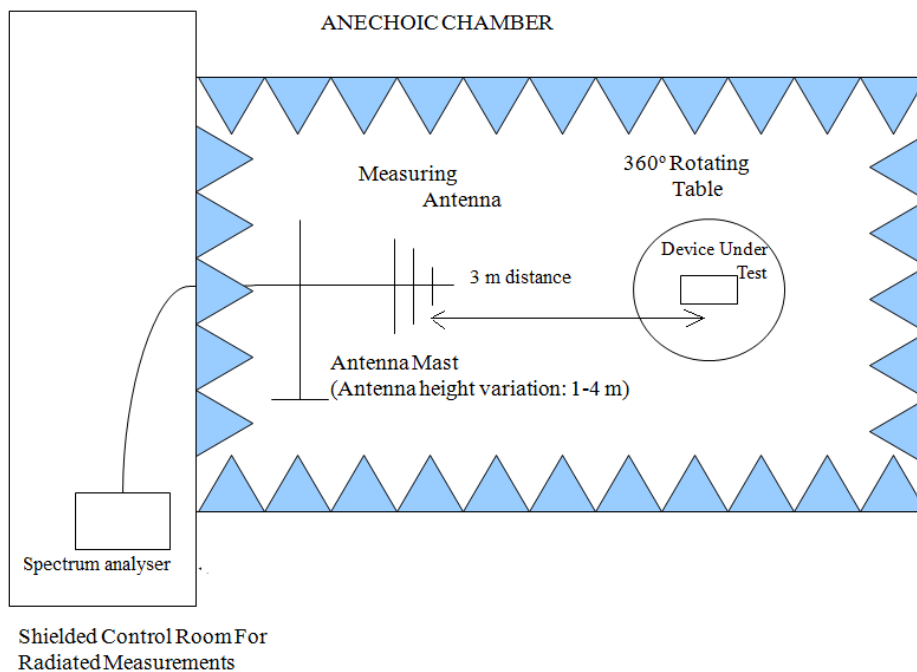
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-10 GHz (1 GHz-18 GHz Double ridge horn antenna).

For radiated emissions in the range 1 GHz-10 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

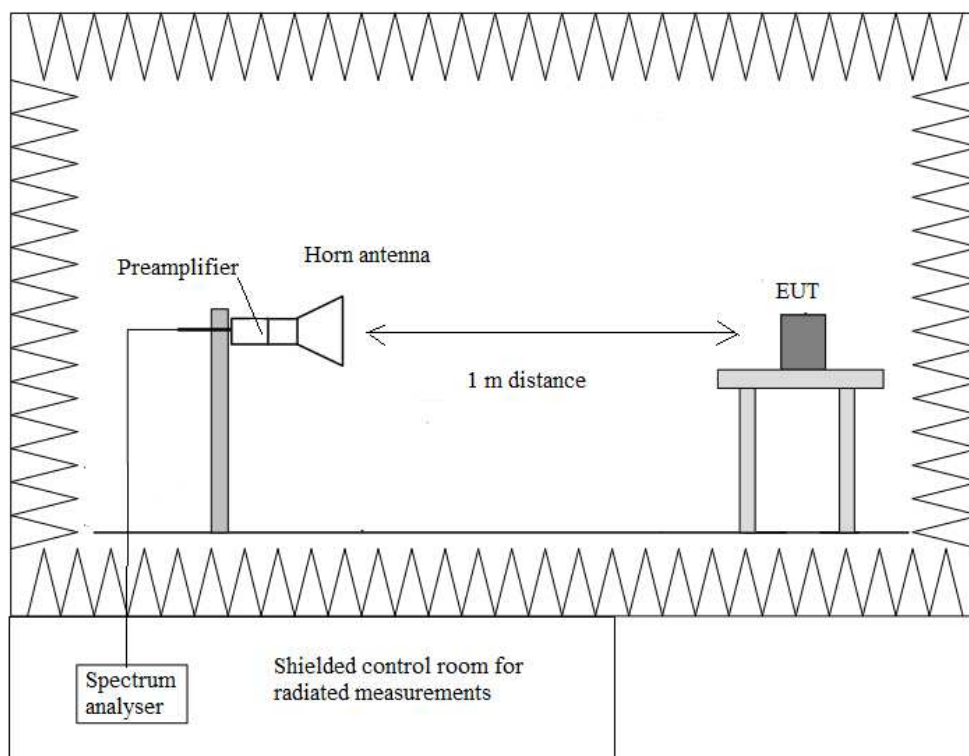
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

Radiated measurements setup $f < 1$ GHz



Radiated measurements setup $f > 1$ GHz



FCC Section 15.247 Subclause (d). Emission limitations radiated (Transmitter)

SPECIFICATION

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)):

Frequency Range (MHz)	Field strength ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-1000 MHz and at distance of 1m for the frequency range 1 GHz-10 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

Frequency range 30 MHz-1000 MHz.

All spurious signals are more than 20 dB respect to the limit.

Frequency range 1 GHz-10 GHz

1. CHANNEL: LOWEST (902.3 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBμV/m)	Measurement Uncertainty (dB)
1.80445	H	Peak	50.92	± 4.69
2.70685	H	Peak	46.14	± 4.69
3.60895	V	Peak	50.33	± 4.69
4.51135	V	Peak	49.77	± 4.69
5.41375	V	Peak	52.41	± 4.69
6.31615	V	Peak	54.90	± 4.69
		AVG	53.94	
7.21855	V	Peak	46.58	± 4.69
8.12065	V	Peak	49.13	± 4.69
9.02275	V	Peak	47.08	± 4.69
9.92485	V	Peak	48.88	± 4.69

2. CHANNEL: MIDDLE (908.7 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBμV/m)	Measurement Uncertainty (dB)
1.81735	H	Peak	51.63	± 4.69
2.72605	V	Peak	45.60	± 4.69
3.63475	V	Peak	50.10	± 4.69
4.54345	V	Peak	49.22	± 4.69
5.45215	V	Peak	48.49	± 4.69
6.36085	V	Peak	54.36	± 4.69
		AVG	53.89	
7.26955	V	Peak	48.22	± 4.69
8.17825	V	Peak	49.03	± 4.69
9.08695	V	Peak	46.97	± 4.69
9.99595	V	Peak	47.62	± 4.69

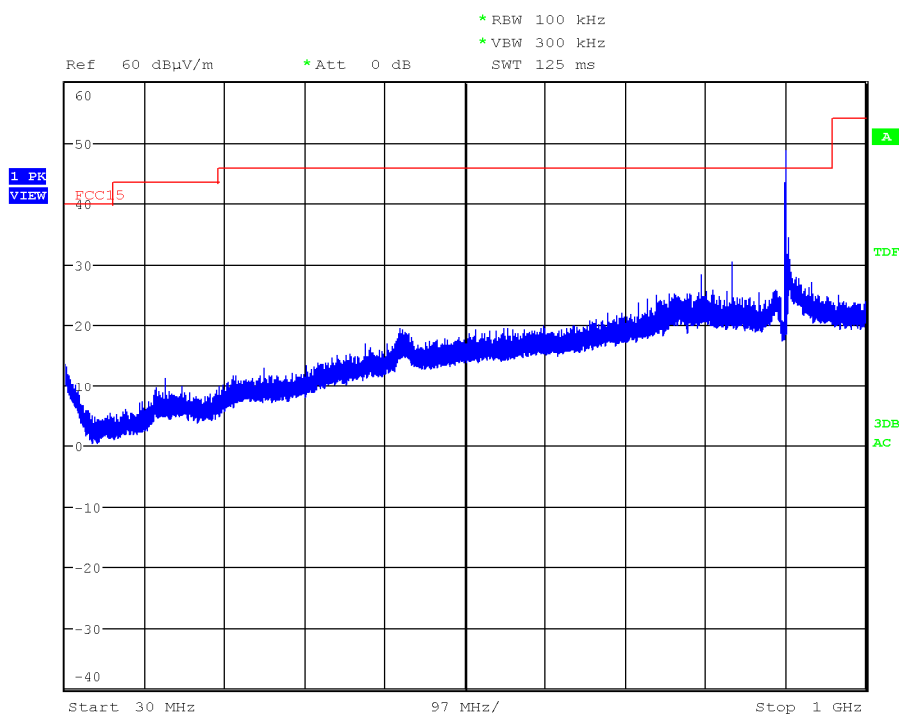
3. CHANNEL: HIGHEST (914.9 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBμV/m)	Measurement Uncertainty (dB)
1.82965	H	Peak	49.63	± 4.69
2.74495	V	Peak	44.37	± 4.69
3.65935	V	Peak	49.65	± 4.69
4.57435	V	Peak	48.45	± 4.69
5.48935	V	Peak	50.17	± 4.69
6.40435	V	Peak	54.22	± 4.69
		AVG	53.15	
7.31905	V	Peak	48.02	± 4.69
8.23375	V	Peak	47.45	± 4.69
9.14905	V	Peak	47.48	± 4.69

Verdict: PASS

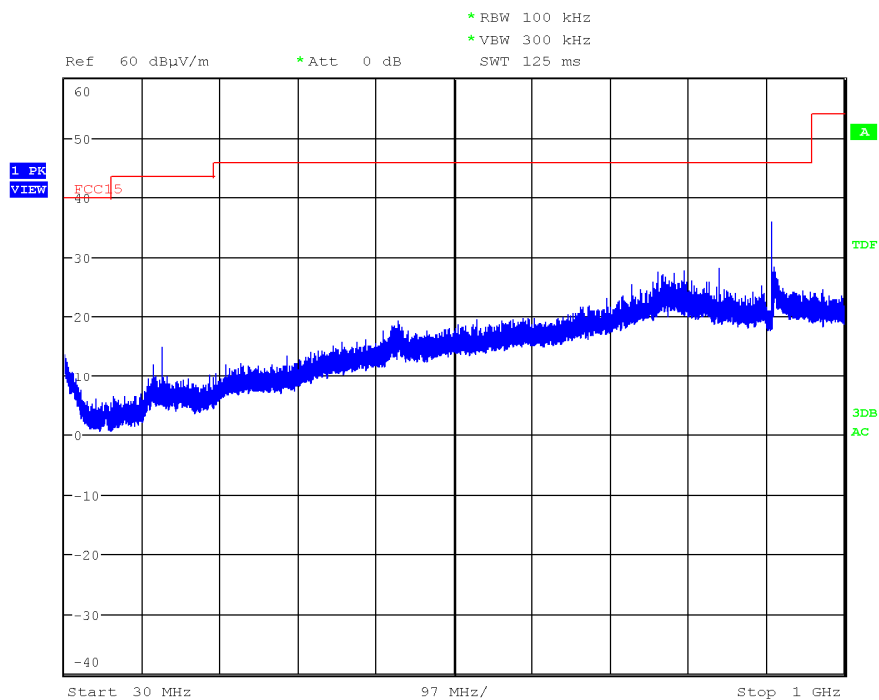
FREQUENCY RANGE 30 MHz-1000 MHz.

CHANNEL: Lowest (902.3 MHz).



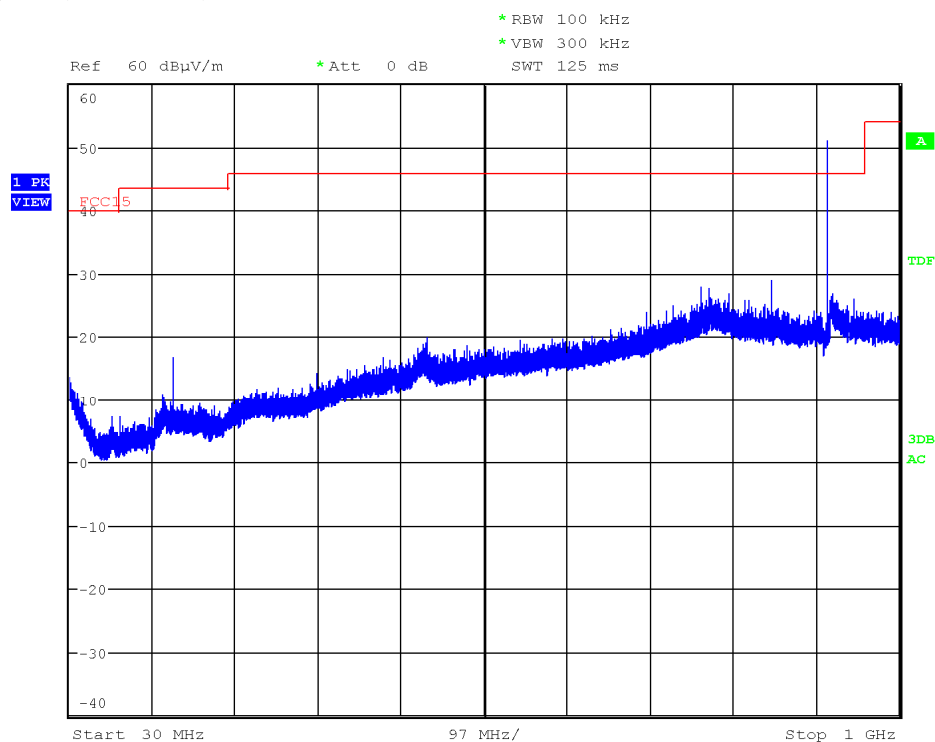
Note: The carrier was attenuated using a Notch filter.

CHANNEL: Middle (908.7 MHz).



Note: The carrier was attenuated using a Notch filter.

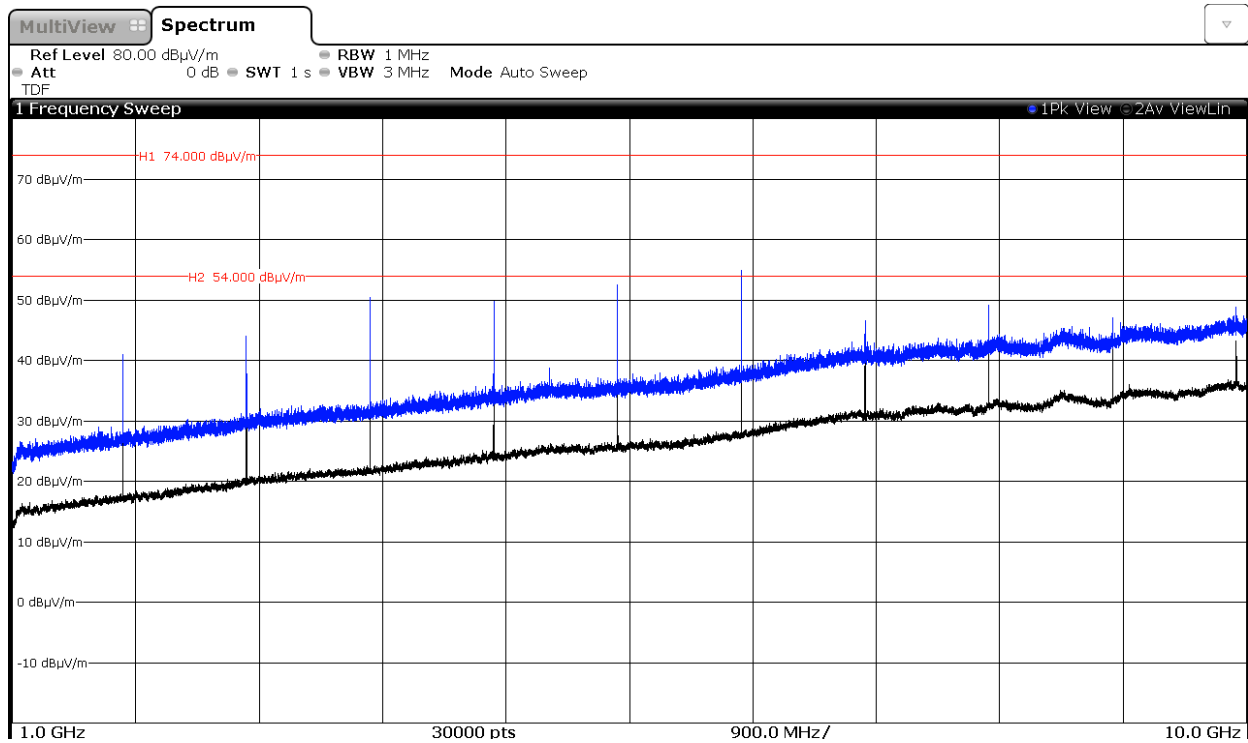
CHANNEL: Highest (914.9 MHz).



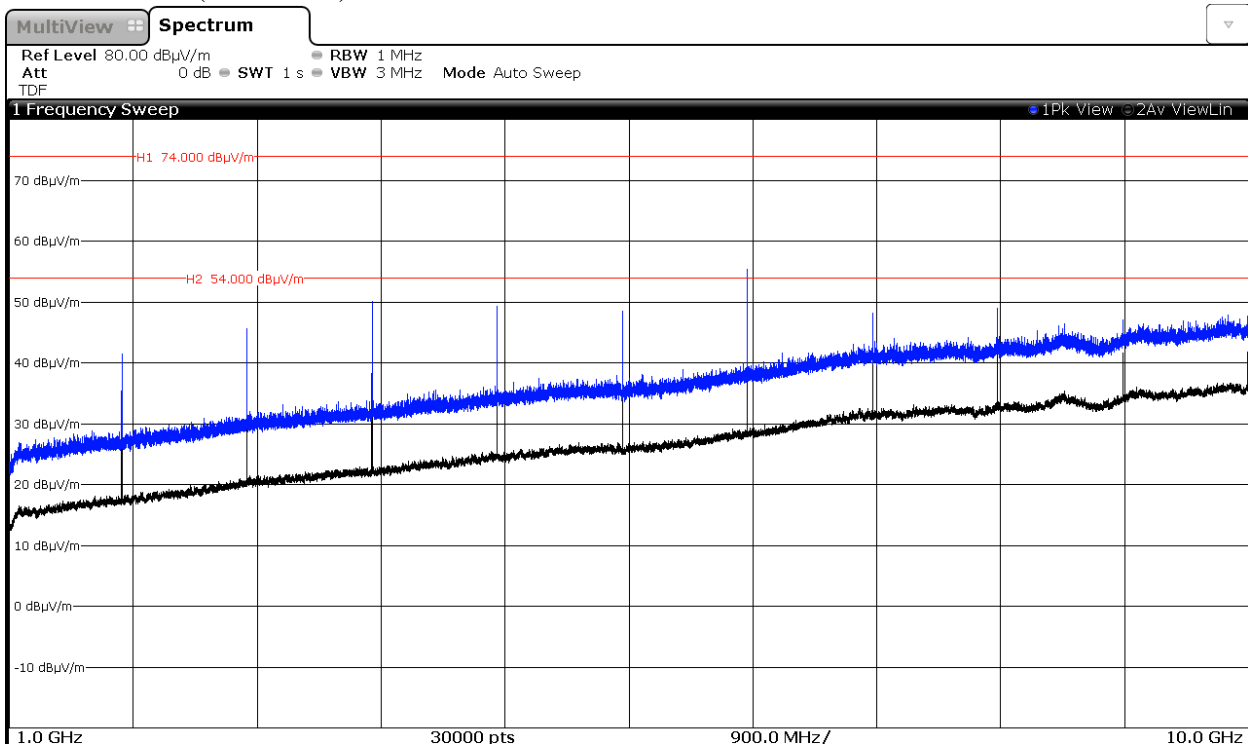
Note: The carrier was attenuated using a Notch filter. The peak above the limit is the carrier frequency.

FREQUENCY RANGE 1 GHz to 10 GHz.

CHANNEL: Lowest (902.3 MHz).



CHANNEL: Middle (908.7 MHz).



CHANNEL: Highest (914.9 MHz).

